

RTCA Special Committee 186, Working Group 5

ADS-B UAT MOPS

Meeting #3

UAT Receiver Sensitivity over Temperature

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SUMMARY

Temperature effects on the receiver sensitivity were examined for the UAT receiver module as well as the full UAT assembly. Two types of tests were used to measure receiver sensitivity: a Bit Error Rate Test (BER) and a message success rate test (MSR).

1. Introduction

An array of receiver tests were accomplished over the operating temperature range of the UAT. Two types of tests were performed: a bit error rates test and a 90% message success rate test. The bit error rate test was performed on a receiver module. In this case the signal did not pass through the antenna switching networks. The message success rate test was performed on a full UAT assembly. The units were subjected to both hot and cold temperature extremes. Measurements were taken at 5 degree increments after a dwell time of at least 15 minutes.

2. Receiver Module Bit Error Rate Test

Two receiver modules were randomly selected from the production line. After checking the alignment and calibration, the units were placed in a temperature chamber for testing. Once placed into the chamber and testing began, no adjustments were made to the unit's power or bias settings.

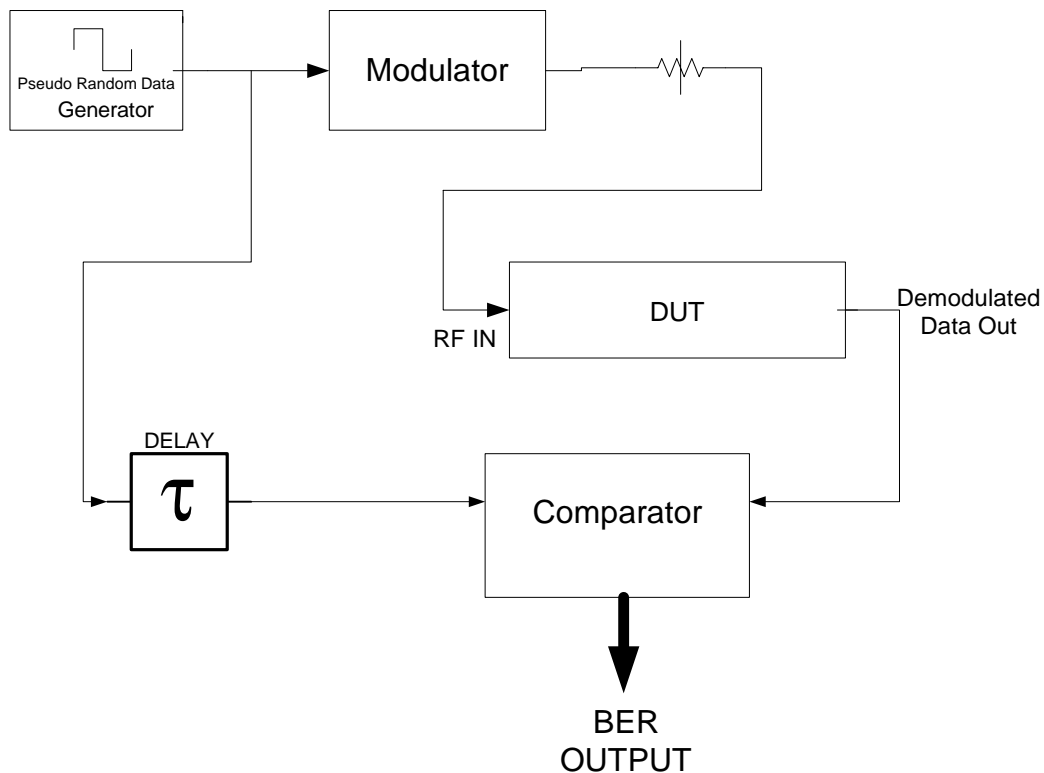


Figure 1. UAT Bit Error Rate test setup

The BER test, performed per manufacturing procedures, is depicted in Figure 1. The procedure involves injecting a RF signal modulated by a pseudo random data stream into the receiver. A variable attenuator decreases the modulator's signal strength before it is injected into the receiver. The receiver's demodulated

data is compared to the original data stream. The comparator voltage is directly proportional to the Bit Error Rate: the higher the voltage, the greater the error. A voltage of 0.05 corresponds to a one- percent error rate.

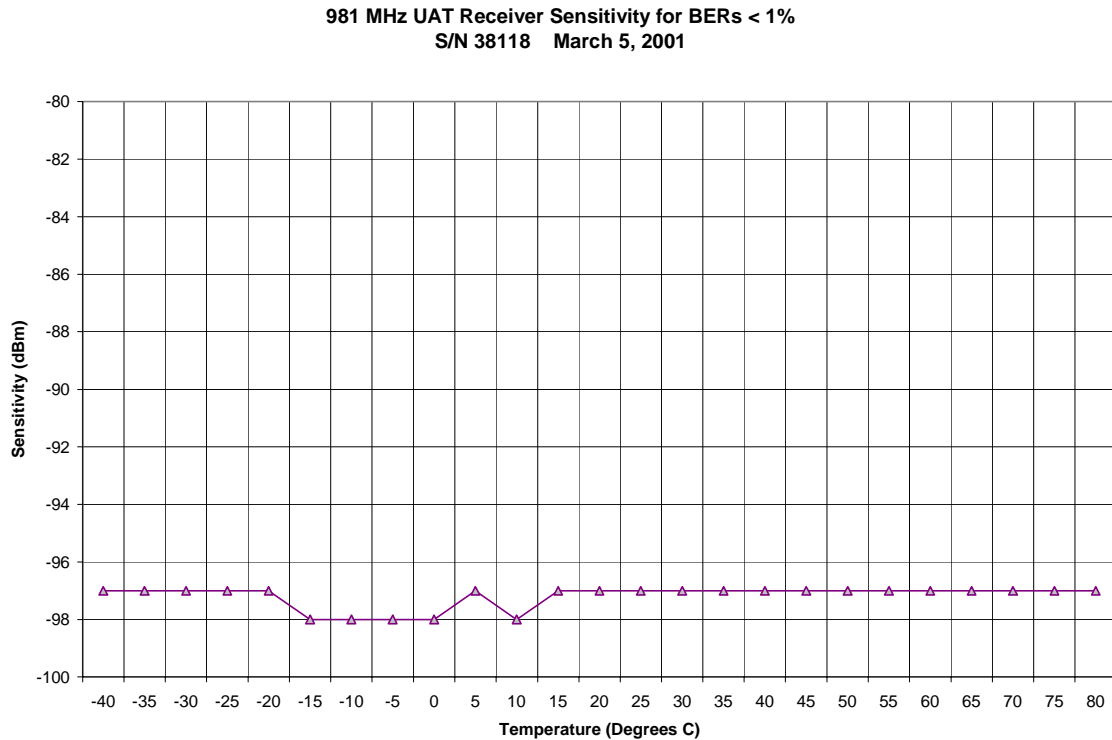


Figure 2. UAT Sensitivity vs. Temperature S/N 58118

The signal level into the receiver was decreased until the BER was 1% at ambient. To expedite the test, the signal strength was not adjusted if the BER improved, only a note was entered into the log. Thus the graphical results are conservative and represent a worst case scenario. Figures 2 and 3 show the BER for two separate UATs.

981 MHz UAT Receiver Sensitivity for BERs < 1%
S/N 143 March 6, 2001

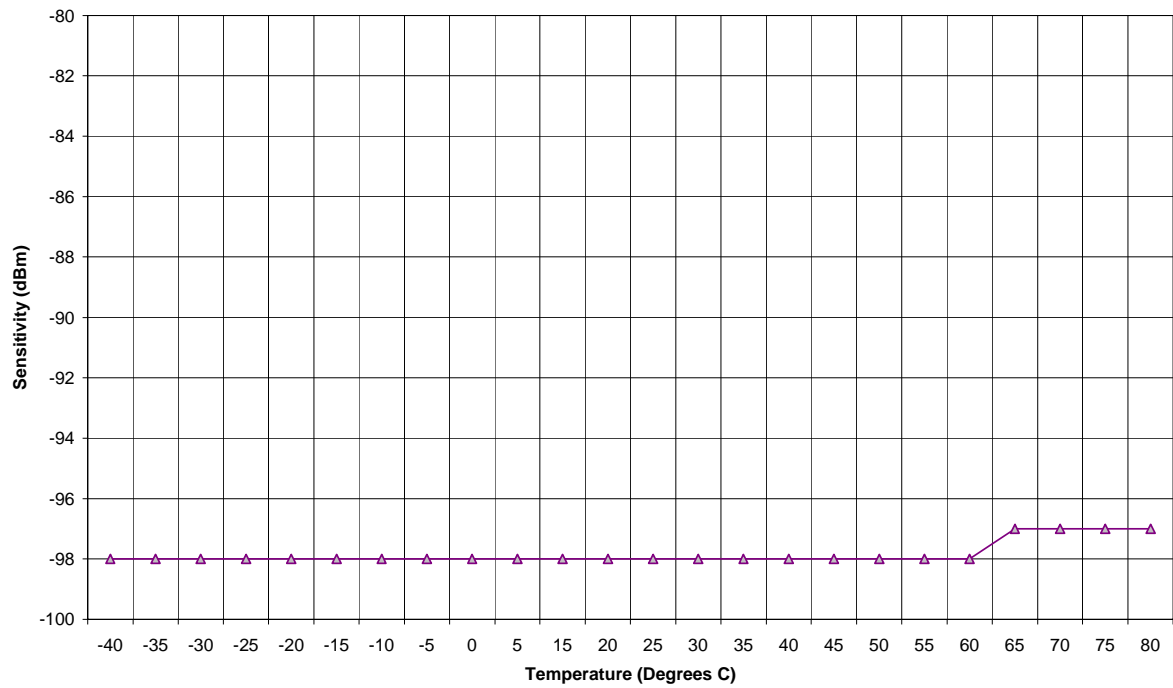
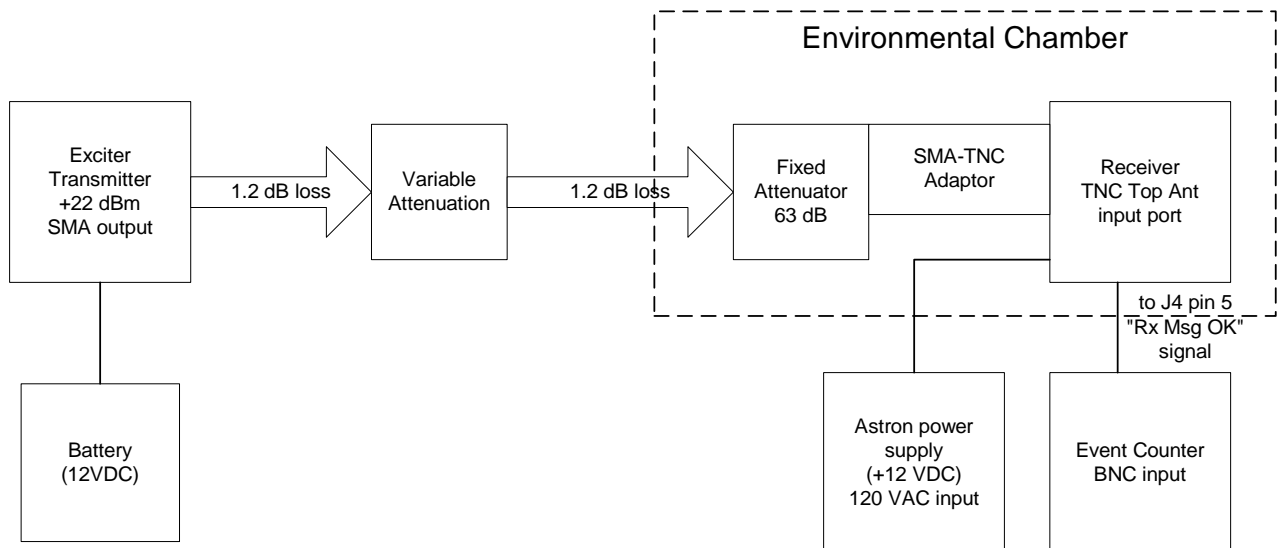


Figure 3. UAT Sensitivity vs. Temperature S/N 143

3. UAT System Message Success Rate Tests

A message success rate (MSR) test uses a UAT as a data generator. The signal is attenuated before being injected into the UAT under test. The UAT's "RX Msg. OK" signal is monitored and compared with the number of originated messages to determine the message success rate for a given signal level. Figure 4 below illustrates the MSR test setup.



All UAT assemblies use software UAT146
Transmit unit grounds TP32 on digital board
Receive unit grounds TP27 for Rx-Only initialization

Drawn: T. Mosher
Date: 21 March 2001

Use ferrite beads on all cables entering chamber.
Cover chamber window with foil.

Figure 4. UAT Message success Rate test setup

The MSR was measured for temperatures varying from -20 to $+80$ degrees C. As expected, the sensitivity degraded at hotter temperatures and increased as the unit was chilled. Figure 5 shows the relationship of message success rate with respect to temperature.

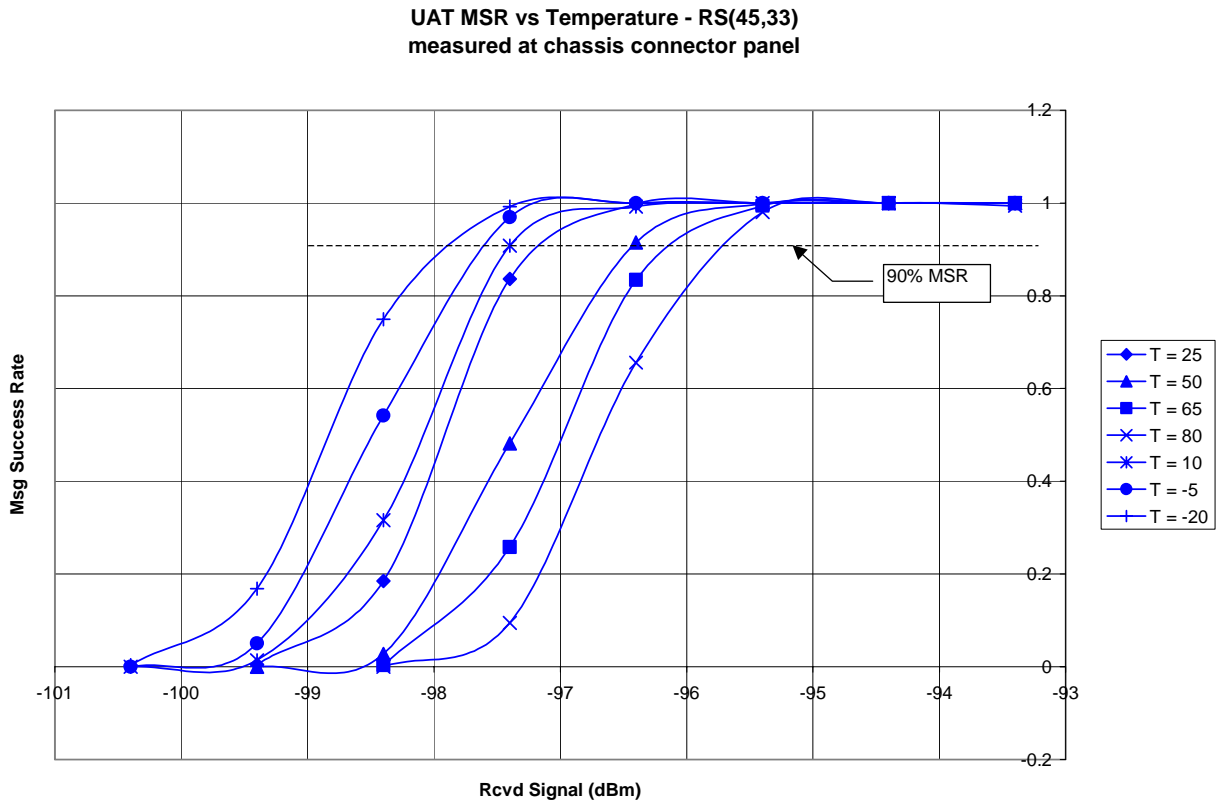


Figure 5. UAT MSR vs. Temperature

4. Conclusions

UATs selected randomly from the production line can meet the -94 dBm sensitivity specification over the -20 to $+80$ degree temperature range. Current IF bandwidths are 1.5 MHz wide and the clock oscillators are on the order of 20 PPM. If the IF bandwidth is decreased, a more precise reference oscillator will be needed to maintain the same BERs and MSRs without reducing the data rate.